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THE COST EFFECTIVENESS OF SALVAGE

PILOT STUDY REPORT

DATED: 28th September 1971.

THE COST EFFECTIVENESS OF SALVAGE

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- Contents -

	<u>Page</u>
1. INTRODUCTION	1
2. SUMMARY OF CONCLUSIONS FROM THE PILOT STUDY	3
2.1 Conclusion concerning the method of data collection	3
2.2 Conclusions concerning the fires visited in the pilot study	4
2.3 Conclusions concerning the rate of incidence of fires suitable for salvage	4
2.4 Conclusions concerning future research	5
3. THE METHOD OF ESTIMATING THE BENEFITS OF SALVAGE	7
3.1 The difficulties	7
3.2 The proposed method	8
3.3 The effort committed to the pilot study	9
3.4 Callout arrangements	9
3.5 Data forms	10
3.6 Low incidence of fires	10
3.7 The extension of the data collection period	11
4. THE RESULTS FROM THE FIRES SAMPLED IN THE PILOT STUDY	13
4.1 The sample of fires	13
4.2 The benefits of salvage at the sample fires	13
4.3 Salvage work done by brigades at the sample fires	14
5. CRITIQUE OF THE METHOD OF DATA COLLECTION	17
5.1 Making estimates at the scene of fires	17
5.2 Disadvantages of the data collection method	17
5.3 Limited opportunities for salvage	18
5.4 Irregular incidence	20
5.5 Use of skilled manpower	20
6. ESTIMATING THE COSTS OF ALTERNATIVE LEVELS OF SALVAGE EFFORT	22
6.1 The costs to be included	22
6.2 Estimates of the costs	23
7. ANALYSES OF FIRE REPORTS	30
7.1 The problem	30
7.2 Classification of incidents	30
7.3 Analyses of daily summary sheets at the pilot brigade	31
7.4 Analysis of 1967 K433 fire report cards	36

	<u>Page</u>
8. THE ADVISABILITY OF FURTHER RESEARCH	38
8.1 The work to be done	38
8.2 The argument in favour of further research	38
8.3 The argument against further research	40
9. PHASE 1 OF THE MAIN STUDY	42
9.1 Setting up the data collection exercise	42
9.2 Data collection	43
9.3 Estimating the benefits of alternative levels of salvage effort	44
9.4 Estimating the costs of alternative levels of salvage effort	44
9.5 Determination of the present level of salvage effort	44
9.6 Recommending a general attitude to salvage and reporting results	46
10. TIME AND COST ESTIMATES FOR PHASE 1 OF THE MAIN STUDY	47
11. POSSIBLE CONTENT OF PHASE 2 OF THE MAIN STUDY	49
11.1 Further analysis of the results of Phase 1	49
11.2 Investigation of alternative methods of organising and equipping for salvage	50
11.3 Investigation of salvage training and drills	50
11.4 Technical development work	51
11.5 Reporting	51

APPENDICES

I	LEVELS OF SALVAGE EFFORT ASSUMED FOR THE PILOT STUDY
II	DATA FORMS
III	POSSIBLE METHODS OF ORGANISING THE DATA COLLECTION FOR PHASE 1
IV	THE INCIDENCE OF FIRES IN NON-DERELICT BUILDINGS IN LONDON, LIVERPOOL AND GLASGOW, BASED ON 1967 K433 FIRE REPORTS
V	THE NEED FOR THE TECHNICAL DEVELOPMENT OF SALVAGE EQUIPMENT
	V/1 Equipment for first line appliances
	V/2 Equipment for salvage tenders
VI	VARIATIONS IN THE FIRE INCIDENCE RATE IN THE PILOT BRIGADE
VII	CLASSIFYING FIRES FOR SALVAGE WORK

INTRODUCTION

Salvage techniques aim to reduce or eliminate the losses caused by an outbreak of fire and by the firefighting operations necessitated by the fire. The main types of salvage activity are:

- the construction of dams and the protection of contents by spreading salvage sheets to minimise damage caused by water either spreading horizontally through a building or percolating downwards to lower floors of a building. This water damage is very important at some fires and can affect both the building structure and contents,
- the ventilation of premises and the spraying of special compounds onto fabrics, to reduce damage caused by smoke and smoke odour,
- the oiling of machinery and the cocooning of machinery or stocks, to reduce damage caused by condensation or steam,
- the temporary repair of broken windows and damaged roofs to prevent damage by inclement weather,
- the securing of premises to prevent losses from pilfering.

In addition, in a commercial situation, salvage activities can considerably reduce consequential loss by bringing forward the date on which a firm is able to recommence its business.

Very little information is currently available on the benefits which are gained or might be gained as a result of salvage work. As a consequence of this lack of knowledge brigades covering similar types of area often vary in the emphasis which they put on salvage. On the other hand, different brigades covering different types of risk will possibly require different approaches to salvage, and some brigades may have few fires which are suitable for salvage techniques. If it were possible for a quantification of the benefits of salvage to be produced, brigades could use such a quantification to assist them in

deciding what level of salvage effort they should provide.

In our proposal dated 6th January 1971 we put forward a method of collecting data to permit an evaluation of the costs and benefits of salvage. As this method is unusual in the context of fire it was agreed that a pilot study be carried out in a city brigade's area. This report describes the pilot study, gives the results and conclusions reached and states our view of what further work should be done. Two subsidiary papers, entitled 'The Components of Salvage' and 'The interactions between Salvage and Firefighting', were also produced during the pilot study.

2. SUMMARY OF CONCLUSIONS FROM THE PILOT STUDY

2.1 Conclusions concerning the method of data collection

Our conclusions concerning the method of data collection are as follows:

- the method of data collection outlined in our proposal is technically and administratively feasible. We were able at individual fires visited in the pilot study to envisage the effects of alternative levels of salvage effort, and were able to make the necessary loss estimates consequent on the alternative levels. During the pilot study we did not have an opportunity of visiting any fires which required extensive salvage effort and so the method has not been shown to perform at the most difficult incidents. However, the data collection team are confident that such incidents could be adequately handled,
- it is possible to use informative messages to brigade control to distinguish fires which are unsuitable for salvage work and it is not then necessary to visit these fires. The number of such fires is much greater than originally thought, and this fact causes the data collection method as tested to be inefficient in its use of skilled manpower,
- some of the information required for the study can be obtained by visiting fires up to four days after they occur. This fact can be used to reduce the under-utilisation mentioned above,
- it is possible to reduce the cost of data collection by about one third by reducing the consultant involvement, employing a local loss adjuster and siting the exercise in a city covered by a Salvage Corps.

2.2 Conclusions concerning the fires visited in the pilot study

The fires sampled were not sufficient in number for any general conclusions to be drawn regarding the cost-effectiveness of salvage. We visited twelve fires which involved losses of less than £1,000 each, and which in total involved a loss of £5,980. Only about 5% (£310) was saved or could have been saved by salvage techniques which were found to be applicable at only three fires of the twelve. Also we visited three larger fires which between them represented an estimated loss of £173,000, but no salvage was possible at these incidents.

We did not visit any fires where the need for salvage was extensive, and at no fire visited was there much interaction between salvage and firefighting. The brigades attending the fires we visited carried out most of the salvage work necessary and achieved over 80% of the possible benefits of salvage.

The costs of undertaking salvage work are considerable, the main items of expense being costs of manning salvage tenders. We estimate that the cost of the present level of salvage effort in the pilot brigade is approximately £18,800 p.a. and that the cost of the 'extra salvage' level as defined in the pilot study would be £44,400 p.a.

2.3 Conclusions concerning the rate of incidence of fires suitable for salvage

The pilot brigade's past records were analysed to determine the incidence of fires which appeared suitable for salvage techniques, and our conclusions were as follows:

- only about 6% of fires are of types at which major salvage techniques are likely to apply. This figure, which is much less than originally thought, has resulted in modifications to the proposed method of data collection. It also has caused us to modify our original conception of the savings

possible from salvage, though much of the nation's fire loss is concentrated in a relatively small number of incidents all of which would be included in the above 6%,

- over two thirds of the above 6% of incidents were of types where it appeared from records that the salvage work necessary at the time of firefighting might reasonably be carried out using men and equipment from first-line appliances. This is an important factor when considering possible methods of organising salvage.

An analysis was carried out of information from 1967 K433 fire cards, with the following conclusions :

- the proportion of fires-in-buildings which appears suitable for the application of major salvage techniques was fairly constant between different brigades,
- only the London conurbation has a rate of incidence of such fires sufficient for the data collection method as originally conceived to be economical in effort; even in the case of the London conurbation some modifications would be necessary.

2.4 Conclusions concerning future research

In our opinion, further research into the cost-effectiveness of salvage is needed. However, we believe this work should be undertaken in two phases, to enable research investment to be curtailed if at the end of Phase 1 it appears that further effort cannot be justified.

Phase 1 of the main study should be aimed at determining, by means of a data collection exercise, the costs and benefits consequent on two possible levels of salvage assumed implemented on a national basis. Hence it should be possible to state whether or not salvage would be cost-effective if generally implemented at each of these levels.

The data collection exercise should be centred on London and Liverpool and should be organised on a one-day per week basis to run for

a period of one year. In this period it should be possible to cover about 250 fires of the types which might be suitable for salvage techniques.

The feasibility of the proposed data collection method is very dependent upon the willingness and ability of brigades and Salvage Corps to afford us the help we require and we have not yet approached them on this point.

Concurrently with the data collection exercise, a survey of brigades should be undertaken to determine current attitudes to, and levels of, salvage activity.

We estimate that Phase 1 will cost a total of £11,520 in consultancy fees plus expenses. You would also incur a loss adjuster's fee which is not included in the above amount.

Phase 2 of the main study would be aimed at considering salvage levels and methods of organising salvage in the context of individual brigades, to produce either configurations which are efficient for various types of brigade, or alternatively, to produce a method which brigades can use to determine what solution is best in their own individual circumstances. This method would include:

- rules to assist in deciding types, location, manning and callout rules for salvage tenders,
- specifications of methods of organising salvage to be carried out at the scene of fires by men from first-line appliances,
- rules for determining salvage equipment to be carried by first-line appliances.

Phase 2 would also include an examination of the need for salvage training and salvage drills and the instigation of certain technical development work aimed at improving the salvage equipment available to brigades.

3. THE METHOD OF ESTIMATING THE BENEFITS OF SALVAGE

3.1 The difficulties

As far as we know, the present work is the first systematic attempt that has been made to measure the extent to which salvage techniques can reduce the losses caused by fire or fire fighting operations. The benefits which result from salvage activity have been described in Section 1.

The difficulties involved in estimating these benefits are:

- fire reports (K.433) do not state whether salvage work was done at fires and therefore it is necessary to design a special data collection method to determine this. To keep the cost of this data collection within reasonable limits, it is preferable to base any estimates of benefit on measurements from a small sample of fires,
- in evaluating the benefit, we are asking the questions "what items would have been saved if various possible levels of salvage were undertaken?" and also "what would be the losses at these levels?" To answer the first question for a particular fire, a level of salvage expertise is needed which is certainly in excess of that likely to be possessed by the officer in charge of the fire. To answer the second question, it is necessary to make an accurate assessment of possible losses and again this is not within the brigade's capacity,
- the variability of fires and the importance of a relatively small number of large fires makes it necessary to take care in generalising from sample data. This is especially important if the number of fires sampled is small.

3.2 The proposed method

We proposed that a team consisting of a salvage expert, a professional loss adjuster and a consultant should observe a stratified sample of fires either during firefighting or shortly afterwards, before the removal of either goods or salvage sheets. The team would be required to make estimates of the losses consequent on a number of possible levels of salvage effort. We were able to define four such levels:

- no salvage effort,
- the present amount of salvage effort,
- the salvage effort which might reasonably have been achieved by a certain predetermined increase in 'salvage cover' above the present level,
- the maximum amount of salvage effort which might reasonably have been deployed at the fire. In this case a note would be made of the amount of salvage effort assumed.

Appendix 1 defines these levels of salvage effort as used in the pilot study.

We suggested that the loss adjuster assigned to the study might need the co-operation of other loss adjusters appointed by insurance companies in order to assess the value of complex machines, or the value of specialised stocks. We proposed that an attempt be made to assess the effect of salvage operations on consequential loss, though our effort should be directed mainly at the estimation of direct loss.

The proposed method of collecting data about fires was unusual in the following respects:

- it made use of a multi-disciplinary team,
- the team attended fires as they were occurring,
- the team were required to imagine salvage being carried out in different ways from those actually used, and to estimate

the effects.

Therefore it was proposed that a pilot study be carried out to test the method, based on the area covered by a city brigade.

3.3 The effort committed to the pilot study

The study team consisted of our consultant, supported by Mr. Plumer who is the Deputy Chief Officer of London Salvage Corps and Mr. Durbin who is the senior partner of Robins Fletcher & Co., Loss Adjusters. Arrangements were made with local firms of Loss Adjusters for us to have any assistance we might require regarding fires we visited.

The study was carried out between 11.00 a.m. Monday and 6.00 p.m. Thursday on two consecutive weeks. The city brigade provided us with a car and relays of drivers and also with office space and sleeping accommodation at a fire station.

4 Callout arrangements

The team turned out on first call to fires and was therefore in attendance only a short time after the brigade's appliances. The categories of fire attended were as follows:

- all fires in the city brigade's area which occurred between 11.00 a.m. and 11.00 p.m. (about two thirds of all incidents occur between these times, though the limits were altered during the course of the study to 8.00 a.m. to 11.00 p.m.),
- all fires at which one jet, or more, was in operation and which occurred during the night in the city brigade's area, or during the day or night in the areas covered by seven surrounding brigades.

Certain types of fire were excluded from the study on the grounds that salvage techniques would probably not be applicable and a fire was therefore not visited if we knew that it was one of the following types:

- grass fires,
- fires in the street,

- fires in derelict or disused buildings,
- fires in huts, sheds, outhouses, lockup garages, and similar buildings,
- rubbish fires,
- chimney fires.

Due to excellent co-operation received from the brigades concerned, callout arrangements worked well and the team were in attendance at fires early enough to enable them to make the estimates required.

3.5 Data forms

At the scene of each fire the team completed data forms which had been specially designed for the purpose. Copies of these forms are given in Appendix II. Form 1 was filled in by the loss adjuster and gives loss estimates for the sample fire for each of the four postulated levels of salvage effort. Form 2 is an analysis form used by the loss adjuster to help him complete Form 1. Form 3, sheet 1 and Form 3, sheet 2 were completed by the salvage expert and specify salvage activities carried out and effort employed for each of the four levels of salvage effort. Form 4 was completed by the consultant as part of the study of the interaction between salvage and firefighting. Notes on the methods used to complete the forms and on the precise meaning of certain items entered on the forms are also given at Appendix II.

16 Low incidence of fires

Eleven incidents were visited during the data collection period, which was only about a quarter of the number we had expected. We think this may have been due to the following factors:

- the weather was abnormally good for the time of year, and this fact might reasonably be expected to reduce the incidence of fires caused by heating systems,

- the statistics on which we had based our estimates of the incidence rate included fires in disused (as opposed to derelict) premises and fires in huts, outhouses, sheds, lock-up garages and similar buildings. These types of fires do not provide opportunities for the use of salvage techniques and were not visited by the data collection team, but it was not realised till late in the study that incidents offering little scope for salvage can constitute a major proportion of a brigade's work.

Section 4 describes the fires visited by the team and presents the estimates of benefits.

3.7 The extension of the data collection period

Because of the shortage of fires in the first two weeks of the study it was decided to extend the period of data collection by about three days. This extension period was also used as a means of assessing to what extent it is necessary for the team to arrive at a fire during the course of firefighting and the following modifications were made to the data collection method :

- if any fires occurred during the night they would be visited the following morning,
- fires occurring in the three days before the extension were also visited.

We visited six incidents during the three days, all of which had occurred before the start of the period and one of which had occurred four days previously. At two of the six incidents it was not possible to gain entry because in one case the fire involved a room at the back of a Methodist chapel and the chapel was not attended, whilst in the other case the fire involved a house where the householder was out on two occasions when we called. In both cases, however, we doubt whether

salvage techniques could have been of much value.

The details of the other four incidents are also given in Section 4.

4. THE RESULTS FROM THE FIRES SAMPLED IN THE PILOT STUDY

4.1 The sample of fires

Only fifteen fires occurred in the periods covered by the pilot study, whereas we had hoped to cover about forty fires. As a consequence, the fires visited cannot be considered to be a valid basis for generalisations on the benefits of salvage. Some observations on the low rate of fire incidence in the pilot study are included at Appendix VI.

The sample included a surprisingly small number of fires in domestic premises, there being only five incidents of this type. At only one of the non-domestic fires was it necessary for the brigade to undertake any salvage work and in this case the work was not of major importance. We did not have the opportunity for visiting any incidents of the type ideal for salvage operations, namely severe fires in the upper floors of industrial or warehouse premises where stocks etc. below are at risk from water damage.

4.2 The benefits of salvage at the sample fires

Table 4.1 gives a short description of each fire visited with the methods of extinction used, an estimate of the loss, an estimate of the benefits of any salvage operations which were carried out at the fire and an estimate of the possible further benefit which might have been gained if 'extra salvage' or 'maximum salvage' had been done. These levels of salvage are defined in Appendix I.

It can be seen that only three incidents were suitable for salvage operations by the brigades attending and that the benefits of salvage could only have been £310 out of a total possible loss of about £179,290 (i.e. £178,980 lost + £260 saved by existing salvage). The brigades attending the fires carried out most of the salvage work necessary at the incidents visited and achieved over 80% of the possible benefits of salvage.

Three incidents out of the fifteen visited accounted for £173,000 out of the £178,980 total loss incurred and salvage operations were not

possible at any of these larger incidents. This concentration of loss in the larger type of incident was as expected, but it is not possible to form any conclusions on the applicability of salvage at such incidents since we have sampled so few.

The remaining twelve incidents all had losses of £1,000 or less and accounted for the remaining £6,290 possible loss. The potential benefit of salvage at these incidents was £310, about 5% of the possible loss. Again the sample size is too small to enable any confidence to be attached to this figure as an estimate of the benefits of salvage.

The consequential loss at the fires sampled was estimated at £24,500. Of the £310 potential benefit of salvage, £260 was estimated to arise from a reduction in direct loss and £50 from a possible reduction in consequential loss.

4.3 Salvage work done by brigades at the sample fires

In the case of the three fires sampled which were suitable for salvage work to be undertaken by the brigade, the firefighting was well within the capabilities of the appliances in attendance and men were soon available to enable the necessary salvage work to be done. There was no need for specialised salvage equipment. Thus in the pilot study interactions between salvage and firefighting were not important.

The salvage work carried out is described in Table 4.2. Only three of the salvage activities specified on data form 3 sheet 2 were found to apply to the fires visited.

TABLE 4.1 THE SAMPLE OF FIRES

Loss estimates made by team

<u>Fire No.</u>	<u>Type of building</u>	<u>Actual loss</u>	<u>Extra loss if no salvage</u>	<u>Reduction in loss if 'extra' salvage</u>	<u>Additional reduction in loss if maximum salvage</u>
		£	£	£	£
1	Potato merchant's single-storey warehouse.	700	-	-	-
2	Undertaker's single-storey stores.	900	100	50	-
3	Tyre remoulder's single-storey building.	500	-	-	-
4	Private dwelling house.	100	-	-	-
5	Private dwelling house downstairs unoccupied.	750	-	-	-
6	Private dwelling house.	450	100	-	-
7	Private dwelling house.	80	-	-	-
8	Private dwelling house.	800	60	-	-
9	Manufacturers of rulers.	150	-	-	-
10	Cricket pavillon, wood construction.	600	-	-	-
11	Social club, canteen and store, two storeys and basement.	000	-	-	-
12	Open fronted timber mill.	600	-	-	-
13	Ballroom and office some fire spread to four shops.	500	-	-	-
14	Bookmaker's premises single storey.	800	-	-	-
15	Gas board showroom.	50	-	-	-
		980	£260	£50	-

*See Section 7.2.

TABLE 4.2 SALVAGE OPPORTUNITIES AT SAMPLE FIRES

Fire Number	2	6	8
Description of incident	Severe fire in undertaker's store-room	House fire	House fire
Parts of building involved	Ground floor and room 20% damaged by fire	Contents of first floor bedroom 50% damaged by fire	Contents of airing cupboard and 15% roof space
Method of extinction	1 jet	1 hose reel	2 hose reels
<u>Salvage activities applicable</u>			
(i) Covering contents with waterproof sheets.			
Contents protected	50 coffins	Ground floor living room	Hall and landing
Importance of activity	Little	Fair	Fair
Effectiveness of brigade	100%	100%	100%
Number of sheets used	4	1	4
Number of sheets avail.	12	6	8
(ii) Protection of carpets			
Carpets protected	n.a.	n.a.	Fitted carpet in hall, stairs and landing covered by sheets
Importance of activity	n.a.	n.a.	Fair
Effectiveness of brigade	n.a.	n.a.	100%
(iii) Protection from inclement weather			
Activity	sheeting roof	n.a.	Replacing tiles
Importance	Little*	n.a.	Little
Effectiveness	0%	n.a.	100%
Effort employed during firefighting	2 men for 5 minutes	2 men for 5 minutes	2 men for 5 minutes
Effort employed during recovery period	-	-	2 men for 15 minutes

* Value estimated at £50 consequential loss

5. CRITIQUE OF THE METHOD OF DATA COLLECTION

5.1 Making estimates at the scene of fires

We found no difficulty in making the estimates we needed when we were able to attend incidents during firefighting or shortly afterwards (say within 20 minutes of the first call). Although the incidents attended did not include any where the need for salvage was extensive, the team felt that it would have been possible to make the necessary estimates at such incidents.

In the cases where the team visited large incidents up to four days after their occurrence, we are confident that it would have been possible to identify what salvage measures were undertaken and the maximum salvage that might have been undertaken and also, with rather less accuracy, the probable effect of these measures. However, it would be difficult to envisage the firefighting situation well enough to say whether the brigade in attendance might reasonably have carried out more salvage work with the men at its disposal on the fireground.

In the case of small incidents the recovery period is much shorter and it is therefore necessary to visit the incidents as soon as possible if estimates are to be accurate. In this type of incident, however, it should normally be feasible for the brigade to carry out any necessary salvage work with the manpower they have available at the incident.

We conclude that the data collection method, as operated during the pilot study, is technically able to produce the results required of it.

5.2 Disadvantages of the data collection method found during the pilot study

As a result of the experience gained during the pilot study, we have identified the following disadvantages of the data collection method :

- salvage is not possible at most fires. Therefore, only a small proportion of all fires occurring in a brigade area need be visited. During the pilot study, the utilisation of the data collection team was lower than anticipated,

partly for this reason,

- it is not always possible to tell in advance whether a fire will provide salvage opportunities. Of the fires which do need a visit, on the basis of early information, it appears from the pilot study that less than one-third are suitable for salvage techniques,
- the irregular incidence of fires, in a brigade area, for which no adequate prediction method exists at present, can result in long time gaps between the occurrence of fires. During the pilot study, this contributed to the low utilisation of the team,
- the method as organised in the pilot study used skilled manpower and a considerable level of co-operation from brigades. Therefore the method was expensive to operate,
- the need for the team to visit the scene of a fire limits the speed of data collection. It is probably not possible to visit more than four to six fires per day in an area large enough to give a reasonable incidence rate.

Possible methods of overcoming the above disadvantages are discussed in the following sections.

5.3 Limited opportunities for salvage

At the beginning of the project we overestimated the proportion of incidents at which salvage methods might apply. It was realised that chimney fires, rubbish fires, fires in the street or fires in derelict buildings could be excluded from the sample. Our estimate of the incidence rate of fires in the pilot brigade excluded such fires. However, we had not realised that many of the remaining incidents would be trivial from a salvage point of view and therefore could be eliminated without the need for a visit. During the course of data collection, we gained knowledge regarding further types of fires which do not normally provide salvage opportunities and which the team would be able to distinguish

either on the initial call or on an early informative message.

We added to the class of all fires which the team would not need to visit the following types of fire :

- fires in sheds, greenhouses, garages, huts etc.
- fires in unoccupied buildings,
- fires which were out when the brigade arrived,
- fires which the brigade extinguished by smothering, by the use of a fire extinguisher, or by removing burning articles from the premises.

The remaining fires were further subdivided, creating four classes in all, as follows :

- Class A - fires at which salvage is likely to be of no value,
- Class B - fires at which salvage is likely to be limited in value,
- Class C - fires at which salvage is likely to be of considerable value,
- Class D - otherwise unclassifiable fires, at which salvage may or may not be of value.

Note : The above method of classifying fires is not related to classifications used for other purposes e.g. firefighting.

These classes are fully defined in Section 7.2.

An examination of past incidence showed that 94% of the fires which occurred in the city area from June 1970 to May 1971 fell into Class A. Therefore the utilisation of the data collection team was reduced considerably from its expected level. On the other hand, the proportion of fires remaining is not very efficient as a predictor of which fires will need salvage techniques. Of the twelve fires which the data collection team did visit and which were not in Class A, only four were suitable for the application of salvage techniques.

It is therefore apparent that in a brigade with the mix of risks that we found in the pilot brigade, the opportunities to apply salvage techniques were infrequent.

To achieve an incidence of fires sufficient to keep a data collection team fully occupied, this type of study will need to cover many brigade areas, or brigade areas with a high incidence of fires in Classes B, C and D.

5.4 Irregular incidence

The incidence of fires is irregular and, in the short term, might be influenced by factors like changes in the weather or by other unpredictable factors. This can result in long gaps between fires and hence in inefficient utilisation of the data collection team. There are two ways in which the utilisation can be increased. Firstly, further studies could be based on an area where the underlying rate of incidence of suitable fires exceeds that which can be handled by the team by a factor of between two and four, so that the number of long gaps is reduced. Secondly, advantage could be taken of the demonstrated ability of the team to make certain types of observation up to three or four days after a fire which will allow a backlog of work to be maintained.

5.5 Use of skilled manpower

The pilot study team consisted of a consultant, a loss adjuster and a salvage expert operating in an area away from their homes and working full time on the data-collection work. The consultant's involvement covers methodology, statistics and organisation and this involvement could be reduced in future exercises, probably to about half or one-third of the present level. It is not essential for the consultant to be present when observations are made at fires, provided that the other members of the team are conversant with the methodology involved.

If fires which occur during the night were to be visited the following day and if a loss adjuster from a local office was employed for the study then the team could work near-normal hours (say 11.0 a.m. to 7.0 p.m.), the need for the brigade to provide accommodation and transport

at night would be eliminated and it might be possible for the loss adjuster to do other work during slack periods. We do not see any way of avoiding the full involvement of a salvage expert in the data collection and, unless data collection is confined to areas of the country covered by or near Salvage Corps, an extended data collection exercise will impose a considerable strain on Salvage Corps by taking a high ranking officer away from his base. By sharing the workload between Salvage Corps and between individuals within Corps the disruption could be reduced.

6. ESTIMATING THE COSTS OF ALTERNATIVE LEVELS OF SALVAGE EFFORT

6.1 The costs to be included

There are two main types of cost associated with salvage work. The first type of cost is that of providing accommodation, capital equipment and materials such as salvage sheets and the second is that of providing manpower to undertake salvage work.

The estimation of the first type of cost is relatively easy and involves :

- specifying and costing accommodation requirements for salvage tenders etc.
- specifying equipment requirements and hence, by using estimates of the life and initial cost of each type of equipment, calculating equivalent annual costs,
- allowing for repairs and maintenance of equipment.

The estimation of the cost of providing manpower to undertake salvage work is more difficult. The following categories of manpower cost must be allowed for :

- the cost of manning salvage tenders and the costs of any other specialist labour largely committed to salvage, such as any administration cost involved in recording the position and condition of salvage sheets. Little difficulty ought to be experienced in estimating these types of cost,
- the cost of a delay in the return of firefighting appliances to station consequent on their manpower being employed on salvage work. This delay results in a temporary and marginal reduction in fire cover, which is not easy to value. For the purposes of this project we have assumed that the present level of fire-cover is correct in the economic sense and that the cost to the community of a (permanent) marginal decrease in fire cover

would therefore be roughly counterbalanced by the wages costs saved. We have therefore taken the value of any extra time spent on salvage work as being approximately equal to the average hourly cost of the firemen involved,

- the cost of diverting effort at the scene of the fire from firefighting to salvage. This is difficult to estimate since it takes place only for a short period and depends on the value of the firefighting concerned. However, an upper limit to this value can be obtained through the argument that it is normally possible to obtain extra manpower, to assist firefighting, from nearby fire stations and that therefore if firefighting is correctly organised the value of marginal men on firefighting should be approximately equal to their value as fire cover. This enables the above approximation for the value of fire cover to be used. Therefore, we have again taken the value of time spent on salvage work as being equal to the average hourly cost of the firemen involved, though we are aware that the estimates cannot be regarded as being accurate,
- the cost of time spent on inspecting, maintaining and cleaning salvage equipment and on salvage drills. These activities fractionally reduce fire cover which again has been valued at the average hourly cost of the manpower involved. This estimate is also approximate.

6.2 Estimates of the costs

This section gives estimates of the annual costs of providing, in the pilot study brigade, the alternative levels of salvage effort

specified in Appendix I of this report. Costs of salvage tenders are based on actual costs incurred by a Salvage Corps for the maintenance and running of a small 35 cwt tender, though mileage estimates, wages costs and wages charges are based on levels estimated for the pilot brigade. In order to convert capital expenditure to equivalent revenue expenditure we have used the concept of 'equivalent annual mortgage repayment cost'. This is the fixed annual sum necessary to repay a loan of amount equal to the initial capital expenditure, assuming that the term of the loan is equal to the estimated life of the item concerned and that the rate of interest is 10% p.a. We have made an attempt to differentiate between out-of-pocket expenses and other types of expense.

Firemen's time is charged at a rate of 67p per hour, which allows for wages and wages charges as follows:

$$\frac{\text{£1,945 p.a.} \times 3 \text{ watches}}{365 \times 24 \text{ hours}} = \text{£0.67 per hour}$$

Our estimates of the costs of providing the alternative levels of effort considered are as follows:

	Out-of-pocket expenses <u>£ p.a.</u>	Other Costs <u>£ p.a.</u>	Total <u>£ p.a.</u>
<u>The present level of salvage effort:</u>			
Cost of one salvage tender (see table 6.1)	13,400	2,700	16,100
Costs of carrying out salvage by first-attendance appliances and at fires which the salvage tender did not attend (see table 6.2)	<u>100</u>	<u>2,600</u>	<u>2,700</u>
	<u>13,500</u>	<u>5,300</u>	<u>18,800</u>
<u>Extra salvage effort (based on 2 salvage tenders):</u>			
Total costs of tenders, manning and equipment (see table 6.3)	<u>39,400</u>	<u>5,000</u>	<u>44,400</u>
<u>Maximum salvage effort</u>			

We were unable to cost this level because in no case was the effort required in excess of the 'extra salvage effort' above.

TABLE 6.1 THE PRESENT LEVEL OF SALVAGE EFFORTCost of one salvage tenderOut-of-pocket expenses£ p.a.

Operating costs:

Petrol & Oil, based on an average usage of 15 gals/ month

15 x 12 x 33p

60

Maintenance & repairs excluding labour

50

Insurance

50

Salaries, National Insurance, Pensions etc.

3 Sub-officers x £2,214 p.a.

6,642

3 Firemen x £1,945 p.a.

5,835

Total operating costs for salvage tender

12,637Capital costs:Initial
Outlay
£Life
(years)Equivalent Annual
Mortgage Repayment
Cost £ p.a.

Vehicle & equipment

Chassis, coachwork, fittings

1,280

12

188

Radio

200

8

38

Sumo Pump

200

5

53

BA sets

100

10

16

Salvage Sheets etc.

350

15

46

Hose & other equipment

550

10

90

2,680

431

Initial equipment, personnel

Tunic, shoes etc. £130 per
man x 6

780

3

314

Training £15.75 per man per wk

£15.75 x 6 men x 2 weeks

190

4

60

Total Initial outlay

3,650Total repayment
cost805Total out-of- 13,442
pocket expensessay £13,400

Table 6.1 Contd.

<u>Other costs</u>		£ p.a.
Notional rent for premises needed at station and use of common facilities		2,500
Time spent by other appliances attending incidents to which the salvage tender is called, to provide manpower for salvage.		
59 incidents p.a. x one hour each x five men x 67p. per hour		198
<u>Total other costs</u>		2,698
say		2,700
<u>Total cost of salvage tender</u>		<u>£16,100</u>

TABLE 6.2 THE PRESENT LEVEL OF SALVAGE EFFORT

Costs of salvage at incidents not attended by salvage tenderOut-of-pocket expenses

£

Replacement of approx. 14 salvage sheets p.a.
at £7 each,

say 100

Total out-of-pocket expenses

£ 100 p.a.

Other costs

Inspecting salvage sheets:

188 sheets x 1 hr per year x 67p per hour

126

Washing & cleaning approx. 300 sheets p.a.

1 hr each x 67p per hour

201

Administrative work of keeping track of location
of sheets part-time, estimated at

400

Time spent by firemen doing salvage at fires,
rough estimate

300 sheets used x .2 hrs/sheet x 2 men x 67p per hr. 80

Salvage drills, assuming drills take 1 hour each
approx. 2470 hrs/year x 67p per hour

1,655

Training recruits

say 60 men x 4 hours x 67p per hour

160

Total other costs

£2,622 p.a.

say £2,600 p.a.

Total cost of carrying out salvage at incidents
not attended by salvage tender

£2,700 p.a.

TABLE 6.3 "EXTRA" SALVAGE EFFORT

Costs of 2 tenders, manning & equipmentOut-of-pocket expenses£
p.a.

Operating costs:

Petrol & oil, based on an average usage of 150 gals./month

150 x 12 x 33p

600

Maintenance & repairs excluding labour

100

Insurance, £50 per vehicle

100

Salaries, National Insurance, Pensions etc.

6 sub-officers x £2,214 p.a.

13,284

12 firemen x £1,945 p.a.

23,340

Total operating costs

37,424Initial
outlay
£Life
yearsEquivalent annual
mortgage repayment
cost, £ p.a.

Capital costs:

2 vehicles & 2 sets of
equipment, (see Table 6.1
for details)

5,360

862

Initial equipment, personnel:
tunic shoes etc. £130 per
man x 18

2,340

3

941

Training £15.75 per man per
week £15.75 x 18 men x 2 weeks570

4

180

Total initial outlay

8,270

Total repayment 1,983
costTotal out-of-pocket expenses

39,407

say

39,400Other costsNotional rent for premises used at 2 stations
and use of facilities5,000Total other costs5,000

Total cost of salvage tenders

£ 44,400

In each of the alternatives considered the major item of expense is the wages cost of the manpower required for the salvage tender(s). It can be seen therefore that other bases for costing manpower might give significantly different results.

7. ANALYSES OF FIRE REPORTS

7.1 The problem

As already noted, we were surprised at the low incidence of fires requiring the team's attendance during the first two weeks of data collection. We took the opportunity, during the extension, to analyse past records of fires in an attempt to explain this phenomenon. As a result of the findings, the analysis was extended to all other brigades (in England, Wales and Scotland), using the K433 fire reports.

7.2 Classification of incidents

To enable the incidence of opportunities for salvage work to be examined, fires were classified according to their suitability for salvage. (See Appendix VII).

The structure of this classification is as follows :

Class A : Fires at which salvage is likely to be of no value

- fires where buildings were not involved,
- grass fires, rubbish fires, chimney* fires,
- fires in derelict or disused buildings,
- fires in barns, hangars, sheds, cycle sheds, huts, lock-up garages, greenhouses, outhouses, caravans, builders' yards, railway stations, boiler rooms, power houses, transformers, fuel stores, exterior structures, pavilions,
- fires confined to the ground floor of houses or other private occupancies,
- fires confined to the ground floor of buildings which have no basement, where not more than one jet was used,
- fires where the extinguishing agent was not quantities of water (i.e. hosereel or jets) and where no sprinklers, burst pipes, or foam were involved.

* Special techniques are assumed to apply to chimney fires and are not included in this project even though 'salvage' might be involved.

Class B : Fires at which salvage is likely to be limited in value

- fires in second storey, third storey or roof of houses or maisonettes,
- fires in small premises, taken to mean less than 800 sq. ft. ground floor area,
- fires extinguished using one hosereel.

Class C : Fires at which salvage is likely to be of particular value

- fires not in classes A or B in the upper floors or roof of commercial or industrial premises.

Class D : Remaining fires where salvage may or may not be of value

These are mainly fires involving the upper floors or roofs of buildings of over 800 sq. ft., ground floor area used for non-commercial and non-industrial purposes but excluding houses and maisonettes, where more than one hosereel was used to extinguish the fire.

The above method of classifying fires is not related to classifications used for other purposes e.g. firefighting.

It is important to note that not all incidents in Classes B, C and D will provide opportunities for salvage since it is not possible to tell from brigade records or K433 fire reports whether contents were at risk which could have been saved by salvage activity. In particular, during the pilot study, we visited twelve incidents in Classes B, C and D, but these yielded only three cases where salvage activities were applicable.

The classification is intended to be used sequentially and each fire being considered is examined to see if it falls into Class A. If not, it is tested for Class B and so on.

Analyses of daily summary sheets at the pilot brigade

Brief details of all incidents attended by the pilot brigade are entered by the officer in charge of the Brigade's control room onto summary sheets. These details include the address of the incident, description of the premises, nature of the incident and a short description

of the action taken by the brigade.

The study team analysed the summary sheets for the year from June 1970 to May 1971 (about 2,000 sheets altogether) into the various classes for salvage opportunities.

We found that there were relatively few fires in Classes B, C and D. Table 7.1 gives the proportions of the brigade's fires (all types of hazards except chimney fires) which fell in each category and it can be seen that at only 6.2% of incidents was there likely to be a major salvage involvement concurrent with firefighting.

TABLE 7.1 Percentage of incidents in each class
(all types of hazard except chimney fires)

Class	A	B	C	D
Percentage	93.8	4.8	0.6	0.8

It should almost always be possible to undertake any salvage operations which are needed at Class B incidents by using men and equipment from first-line appliances and without calling out a salvage tender. Thus, a salvage tender might need to be called out concurrent with firefighting to as few as 1.4% of the number of fires attended. There might, however, be some incidents in Class B where the salvage tender is needed to enable roofing or other work to be done after the fire is extinguished.

Because of the low incidence of fires in Classes B, C and D it is quite likely that there will be no such incidents on any given day in the pilot brigade and it is very likely that there will be no incidents of Classes C or D, as Table 7.2 shows.

TABLE 7.2 Percentages of the days in one year with given numbers of incidents with salvage potential

Number of incidents	0	1	2	3	4	5	6
Percentage of days with this number of Class B, C and D incidents	44%	32%	13%	8%	2%	1%	0%
Percentage of days with this number of Class C and D incidents	82%	17%	1%	0%	0%	0%	0%

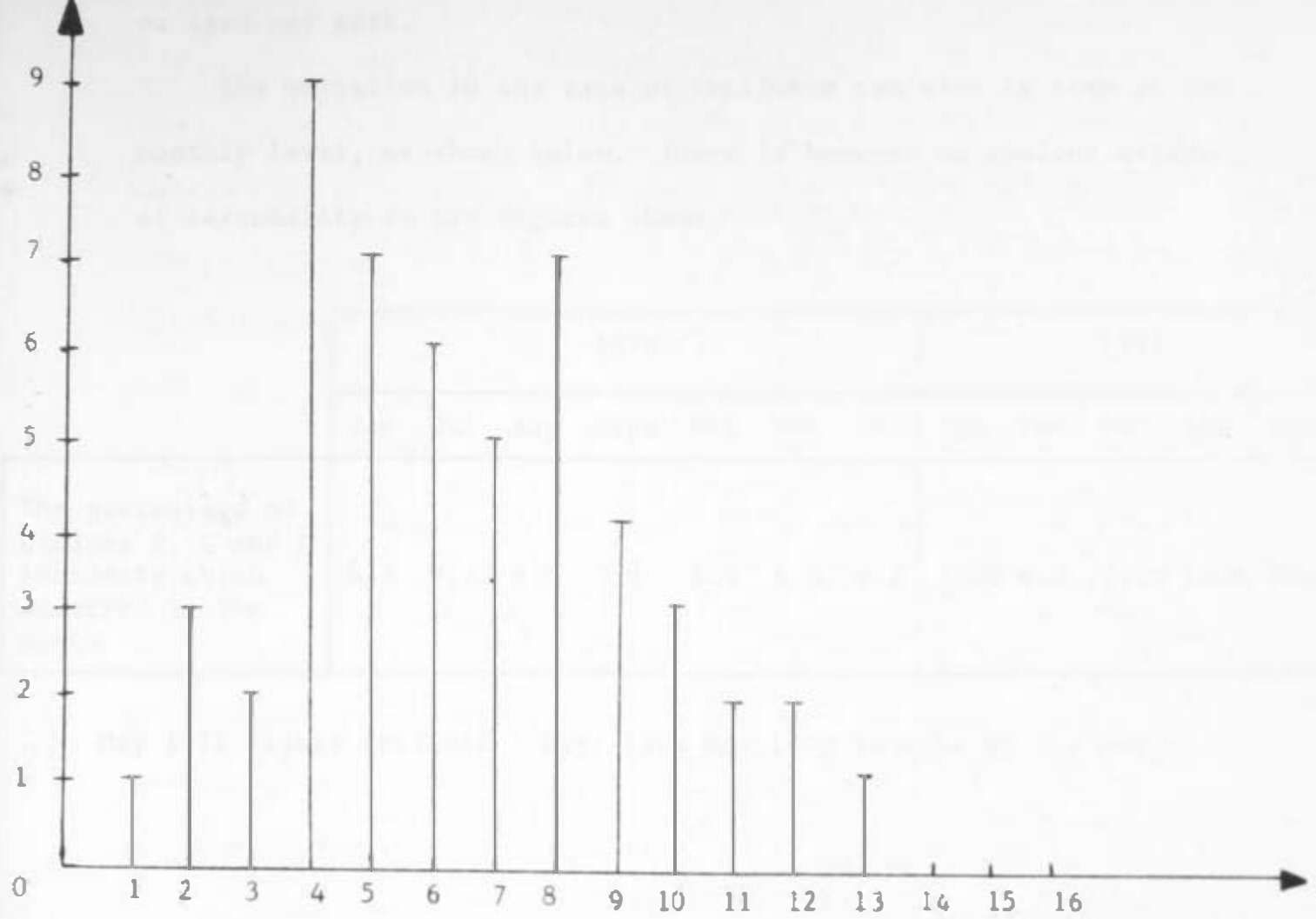
In order to determine the variation in the rate of incidence of fires in a longer period, we drew up the histogram in Figure 7.1 which shows how many weeks there were in the year which had given numbers of incidents in Classes B, C and D.



FIGURE 7.1 Histogram showing the variation in the rate of incidence of fires in a longer period

FIGURE 7.1 FREQUENCY DISTRIBUTION OF INCIDENTS IN CLASSES B, C AND D

No. of weeks
in the year in
which this
number of
incidents occur



No. of incidents
in Classes B, C
and D.

It can be seen that there is considerable variation in the incidence rate, even when a one-week timespan is used. In 15 weeks in the year the incidence rate of Classes B, C and D fires was four fires or less per week.

The variation in the rate of incidence can also be seen at the monthly level, as shown below. There is however no obvious evidence of seasonality in the figures shown.

	1970							1971				
	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May*
The percentage of classes B, C and O incidents which occurred in the month	6.2	9.2	8.6	3.8	8.9	8.3	4.2	11.0	6.2	11.0	10.4	12.2

* May 1971 figure included 3 days from May 1970 to make up the month.

7.4 Analysis of 1967 K433 fire cards

The Home Office have available a computer file containing information about individual fires coded from the 1967 K433 fire reports. At our request, a computer program was written to analyse this file to find out how many fires there are in each of Classes A, B, C and D for each brigade in the country, to enable us to compare the types of fire found in the pilot brigade with those found in other brigades. We found, however, that we had to modify the class definitions somewhat because of the type of information coded on the cards. For example, in the computer analysis, Class A included in-building fires only and not grass fires, rubbish fires, etc. Also, it was not possible to put all fires in derelict or disused buildings into Class A since this information was not always coded on the card. In addition, a more restrictive definition of 'confined to the ground floor' is probably shown on the K433 card than was apparent from summary records, and therefore some fires are put into categories B, C or D which would have been put into Category A if we had analysed brigade summary sheets.

We found that the number of fires in Category B in the 1967 fire card analysis for the pilot brigade was only slightly greater (1.11 times) than the number we had found in our analysis of the brigade's 1970-1971 summary sheets, and that the number of fires in Classes C and D was 1.28 times as great. This was an acceptable correspondence between the two analyses, considering that the base year's source documents and class definitions were different.

When the A/B/C/D percentage breakdowns of different brigades were compared with one another, we found that there was a great similarity between them (e.g. see Appendix IV). The national total of 76,665 in-building fires was split between the four classes as follows: Class A 79%, Class B 16%, Class C 2.6%, Class D 2.0%.

Incidence rates for different brigades were combined in an attempt to find conurbations or areas with a sufficient incidence rate for the data collection method as originally conceived to be employed, to try to avoid relying on 'backlogs' of incidents. It was found that only London had a sufficient fire incidence rate to make this feasible. In London, the number of Classes B, C and D incidents in 1967 was 2,707, an average of 7.4 incidents per day. However, a proportion of these will occur during the night when the team would not be on duty and the rate of occurrence of incidents would not be uniform through time, so even in this case, it would be necessary to make use of a backlog of incidents.

8. THE ADVISABILITY OF FURTHER RESEARCH

8.1 The work to be done

The arguments for and against undertaking further research into salvage activities are set out in this section. We are of the opinion that the argument in favour of further research is much stronger than that against and that the research work as specified later in this report should be started as soon as possible. However, we think the work should be undertaken in two phases and that review meetings should be held, at which the work can be curtailed or redirected if necessary.

Phase 1 should have as its aims :

- to determine brigades' current attitudes and activities with respect to salvage,
- to determine the costs and benefits of alternative levels of salvage effort, assuming these levels to be implemented nationally.

Phase 2 should have as its aim :

- to develop methods for determining the organisation and equipment necessary for salvage in individual brigades.

Phase 2 is therefore the link between the general treatment of salvage costs and benefits in Phase 1 and possible later implementation work.

8.2 The argument in favour of further research

Currently, brigades have no guide as to what level of salvage effort to provide and so different brigades put different emphases on salvage.

There are two documents which condition the attitudes of brigades to salvage :

Firstly, the Fire Services Act 1947 requires fire brigades :

"to secure efficient arrangements for ensuring that reasonable steps are taken to prevent or mitigate damage to property resulting from measures taken in dealing with fires in the area

of the fire authority."

However, the Act does not define "efficient arrangements" or "reasonable steps."

Secondly, Part 6A of the Manual of Firemanship contains a chapter on salvage, which lists salvage equipment and specifies how these equipments should be used. It does not indicate how much equipment should be carried on first-line appliances, nor does it give rules for deciding on the need for and location of special salvage tenders, and it does not comment on the possible need to increase fire cover to allow manpower for salvage.

We have heard hearsay evidence that different brigades place different emphases on salvage, and we have direct evidence that brigades vary in the amount of salvage equipment available.

Present levels of salvage effort are expensive to maintain.

Current levels of salvage effort are expensive to maintain especially in respect of manpower allocated to salvage tenders. We estimate that salvage effort in the pilot brigade costs approximately £18,800 per annum. Other brigades also spend considerable sums on salvage. The expenditure of such sums requires justification, and so there is a need for a method of estimating the resulting benefits.

In order to determine the correct level of salvage effort, it is necessary to know the benefits which might result from different levels of salvage effort.

The data collection method, as tested in the pilot study, is the best available means of determining the benefits and has been shown to be technically feasible.

The method has the following advantages:

- the benefits are estimated directly, without the use of correlations, pairings or other comparisons,

- estimates are made in full knowledge of conditions prevailing at fires,
- the persons making estimates are specialists and therefore estimates are likely to be more accurate than might be the case if inexperienced personnel were to be employed.

We are aware of no other method of data collection which has comparable advantages.

The results from the data collection will enable estimates of benefit to be extrapolated for individual brigades and so could form a basis from which individual brigades might determine their approach to salvage.

The results of the data collection exercise will comprise measurements of the benefits of alternative levels of salvage effort at a sample of fires. Only those fires which might possibly be suitable for the application of salvage techniques will be included. It will be possible to classify the fires in the sample (e.g. by a B/C/D Classification) to determine what the average benefits of salvage are at given types of incident. By analysing K433 fire report information to determine the incidence of the above types of fire in a given brigade, it will be possible to estimate the benefits of salvage in a particular brigade.

.3 The argument against further research

A data collection exercise would require co-operation from a number of brigades and from Salvage Corps. The extent of the co-operation required from Salvage Corps is indicated in Section 10.

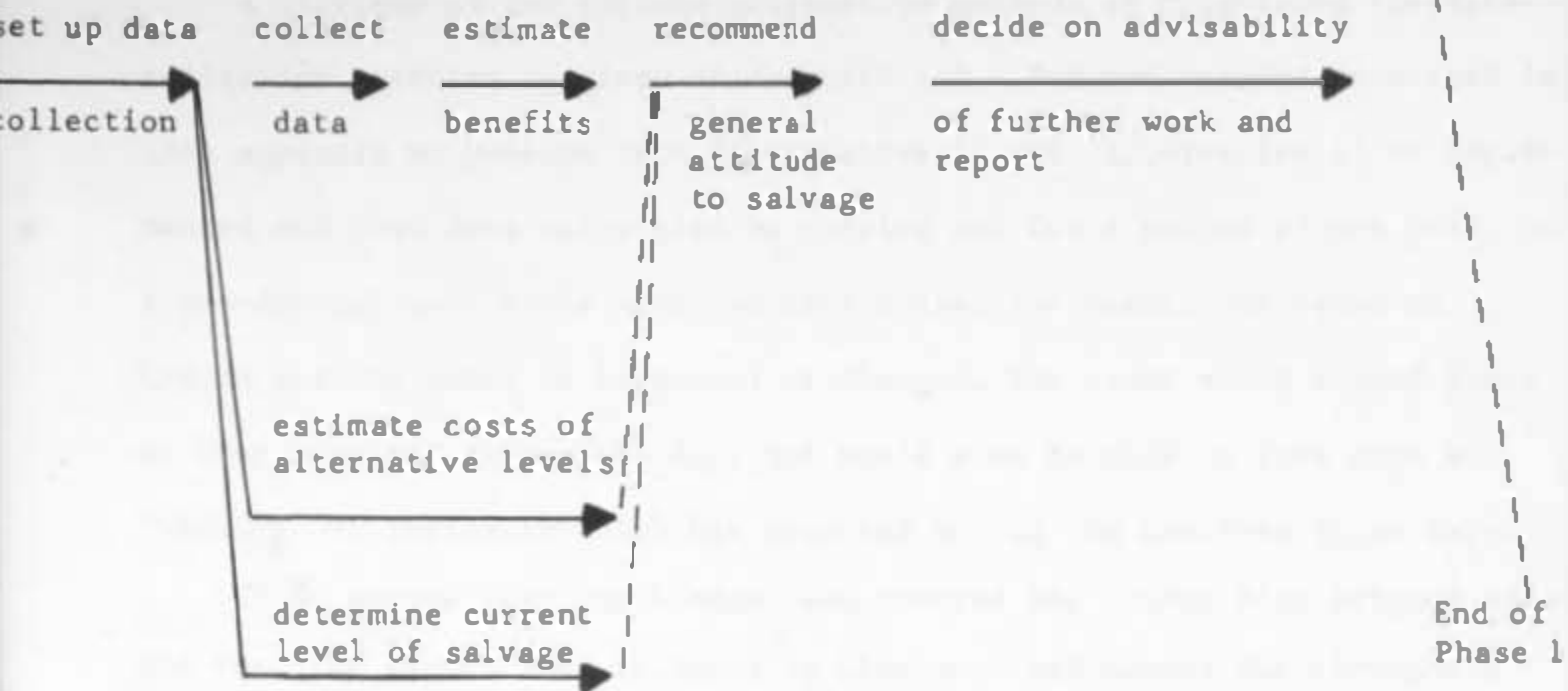
Results may not be available until the end of a fairly lengthy period of data collection (say one year).

The results from the data collection exercise would be too general to be implemented directly and further work would be needed to produce implementable conclusions.

The optimum salvage effort recommended at the end of the study might be similar to the present salvage effort in many brigades and so there might be little further saving possible in these brigades.

PHASE 1 OF THE MAIN STUDY

The diagram below gives the activities comprising Phase 1 of the main study outlined in Section 8.1. These activities are described in more detail in the remainder of this section.



8.1 Setting up the data collection exercise

This activity will comprise :

- discussing our proposals for data collection with Salvage Corps, loss adjusters and co-operating brigades and agreeing administrative arrangements,
- defining what types of incident are to be attended by the team or teams collecting data,
- defining alternative levels of salvage effort.

The teams would not attend Class A incidents as defined in Section 7.2. The definitions of levels of salvage effort will be on the lines indicated below :

- no salvage (but assuming good firefighting practice is used),
- the present salvage effort as employed at the incident. This would be used as a base for other measurements, but cannot be considered to be a uniform level of effort since different brigades and different incidents would be involved,
- the salvage which could have been done by first-line appliances with salvage equipment (to be specified) on the appliances,

- the salvage which could have been achieved by a small salvage tender arriving at the incident within a specified time of the first call.

9.2 Data collection

A critique of the various alternative methods of organising the data collection exercise is given at Appendix III. For the reasons described in this appendix we propose that 'Alternative 2' and 'Alternative 4' be implemented and that data collection be carried out for a period of one year, on a one-day-per-week basis with two data collection teams, one based on London and the other on Liverpool or Glasgow. The teams would attend fires as they occurred during the day, but would also be able to draw upon a 'backlog' of incidents which has occurred during the previous three days.

If we assume that the London team covered the London Fire Brigade area and that the second team is based in Liverpool and covers the Liverpool, Birkenhead, Bootle, St. Helens and Wallasey brigade areas, then we estimate that the number of Classes B, C and D fires occurring during the year would be 2,700 in London and 500 in the Liverpool area as shown in Appendix IV. Assuming that the teams between them would be able to visit about five fires per day, we estimate that they would visit about 250 fires in the period. This number of fires would probably include about 60 fires in Classes C and D and should be sufficient to enable estimates of the benefits of salvage to be made.

We propose to investigate the importance of the time of arrival factor in salvage work by noting, at each incident visited, the latest times at which salvage work could be started without its effectiveness being reduced.

Our proposal has not yet been seen by the Salvage Corps or brigades whose participation would be needed and is therefore tentative at this stage. Neither has it been put to the Chartered Institute of Loss Adjusters. The firm of loss adjusters which assisted us in the pilot study, (Robins, Fletcher & Co. or associated companies) have offices in Liverpool, London and Glasgow and so might be in a position to continue

to assist us with the study if requested to do so.

9.3 Estimating the benefits of alternative levels of salvage effort

Having carried out the data collection exercise, information will be available on the value of each level of salvage at a sample of fires. By classifying fires (e.g. by a B/C/D categorisation, though it may become clear during data collection that some modification would be appropriate), it will be possible to determine the average value of each level of salvage for fires in each class. By analysing K433 fire reports using the Home Office computer file, it will be possible to determine the incidence of each class of fire, and hence, to estimate the benefits which would accrue from a country-wide implementation of each level of salvage. An assessment will be made of the accuracy of the estimates made.

9.4 Estimating the costs of alternative levels of salvage effort

During the pilot study, estimates were made of costs for alternative levels of salvage effort in the pilot brigade. We propose to gross up these figures on a nation-wide basis to give approximate estimates of the costs of alternative levels of salvage. In order to do this we will need certain statistical information about brigades and, possibly, also statistics of fire incidence (e.g. concerning Classes B, C and D fires).

9.5 Determination of the present level of salvage effort

It is necessary to know the current level of salvage effort before deciding, at the end of Phase 1 of the study, what further work should be undertaken.

We propose to conduct one-day visits to about six brigades and based on these interviews, to prepare and issue a short questionnaire to brigades.

The questionnaire would pose the following questions:

- what are the numbers, types, location and usage of the salvage sheets possessed by the brigade, and how many are being carried

on appliances?

- what other salvage equipment is carried on appliances?
- does the brigade possess salvage tenders either as single-use vehicles or as combined-use vehicles?
- what types of vehicles are they and what equipment is carried on them?
- how are the tenders manned, and what methods are used for allocating men to salvage at incidents? What are the callout instructions for salvage tenders, and how many incidents were attended last year where the tender was called out because of a possible requirement for salvage at fires?
- how many members of the brigade have attended salvage training courses in the last five years (by type of course and by rank)? What salvage training is given to new recruits? What salvage drills are done and at what frequency?
- what procedure is followed for the organisation of salvage at fires not attended by a salvage tender?
- does the brigade carry out the following types of salvage work at fires and, if so, approximately how often?:
 - pumping basements and lift wells,
 - forced ventilation of premises after the fire is extinguished,
 - reduction of smoke odour damage by spraying of a special preparation,
 - oiling machinery,
 - temporarily repairing small roof holes,
 - temporarily repairing larger roof holes,
 - temporarily repairing windows,
 - securing premises.

9.6 Recommending a general attitude to salvage and reporting results

Given information from the actions described above, it should be possible to formulate a recommendation concerning the general attitude which should be adopted to salvage, to decide on the advisability of further work as specified in Section 10 and to draw up a report. The reporting stage would depend on the nature of the conclusions reached. It might be necessary to draw up a further report for wide circulation or, if it were decided to proceed with Stage 2, it might be advisable to wait until the conclusion of this work before reporting generally.

10. TIME AND COST ESTIMATES FOR PHASE 1 OF THE MAIN STUDY

This section gives estimates of consultant man-days and other effort which will be required to carry out Phase 1 of the main study. The content of Phase 1 is specified in detail in Section 9.

	EFFORT IN MAN-DAYS		
	<u>Consultant</u>	<u>Salvage Corps</u>	<u>Loss Adjuster</u>
Setting up data collection exercise			
discussing proposals	15	4	4
defining incidents attended	2	-	-
defining levels of salvage effort	2	2	-
Data collection	38	100	120
Estimation of benefits	15	-	-
Estimating the costs of alternative levels	10	-	-
Determination of present level of salvage effort			
design and production of questionnaire	6	-	-
analysis of returns	15	-	-
visits to brigades	10	-	-
Recommending a general attitude to salvage	5	-	-
Planning of future work (Stage 2)	5	-	-
Report writing	25	6	6
Review meetings	<u>10</u>	<u>8</u>	<u>8</u>
	<u>158</u>	<u>120</u>	<u>138</u>

The elapsed time for Phase 1 would depend on the administration time to set up the data collection exercise, but would probably be in the region of 15 months.

Fees

Our fees are now at the rate of £360 per consultant-week, charged on

the basis of time actually spent on the assignment. This rate is inclusive of all normal supervision but excludes outlays such as travelling expenses and hotel accommodation. We estimate that the total consultant time spent on the assignment will be 32 weeks, which will therefore incur a fee of £11,520 plus outlays.

In addition, you will incur a fee for the services of a loss adjuster for an estimated 24 weeks' work. We think that the services of Salvage Corps officers might be made available without fee, but you would be liable for their expenses.

Confidentiality

Our reports will not disclose the identity of individual fires and all information collected during the study concerning losses at individual fires will be treated as confidential.

11. POSSIBLE CONTENT OF PHASE 2 OF THE MAIN STUDY

Having worked out the costs and benefits of alternative levels of salvage and having explored the current situation in Phase 1 of the main study, a decision should be taken on whether or not to proceed with further research effort. If it is decided that the level of salvage effort in many brigades needs to be changed, then further work will be needed to specify which methods of organisation are most efficient. This section describes the types of research which might be done in Phase 2 of the main study, aimed at producing results in a form which can be implemented by brigades.

1.1 Further analysis of the results of Phase 1

Phase 1 will produce estimates of the costs and benefits of alternative levels of salvage, assuming uniform implementation of each level on a national basis. However, in practice it will not be economic to implement the same level of salvage effort in all brigades, since risks covered by different brigades vary greatly. The aims of this part of the study will be to consider each brigade in turn, decide which of the alternative levels of salvage (as considered in Phase 1) appears most appropriate for the brigade, and hence estimate the costs and benefits of a 'mixed' alternative with different levels of salvage assumed in different brigades.

This alternative would then be compared with the present situation in physical terms, and if there is a significant difference between the two alternatives, approximate estimates of the costs and benefits of the present situation would be made for comparison with the 'mixed' alternative.

As a result of the above analysis, we should be able to put forward a more concise argument for changes in the national level of salvage effort; the existence of this form of argument should assist implementation of the results of Phase 2 of the study.

11.2 Investigation of alternative methods of organising and equipping for salvage

As a result of the questionnaire assessment of the current situation (see Section 9.5), we expect to find that different methods of organising and equipping for salvage are now used by different brigades. From the analysis described in Section 11.1, we will have developed a view as to approximately what level of salvage effort might be appropriate for different types of brigade. We propose to combine the above two kinds of information and to interview a sample of brigades which have different methods of organising or equipping for salvage at their respective levels, and possibly, in addition, to interview any brigades which are operating unusual methods of organising salvage or are doing more salvage than our analysis indicates is cost-justified. We also propose to interview Salvage Corps to obtain their opinions on how salvage might be organised in the brigade context.

From the analysis we will list those methods of organising or equipping for salvage which appear to us to be most effective for various types of brigade or, if this is not possible, we will specify a method which individual brigades might use to determine whether any improvement is possible in their current methods of organising and equipping for salvage. The above will include:

- rules to assist in deciding types, location, manning and callout rules for salvage tenders,
- specifications of methods of organising salvage to be carried out at the scene of fires by men from the first-line appliances,
- comments on the salvage equipment which we think should be carried on first-line appliances.

11.3 Investigation of salvage training and drills

If as a result of Phase 1 it is decided that the emphasis on salvage should be increased, a major problem will be the training of brigade

manpower to achieve the maximum possible benefit.

A programme of work may therefore have to be created to enable suitable training courses and drills to be developed.

11.4 Technical development work

Present salvage equipment is technically naive, and little development work has been done. Individual brigades cannot experiment to any large extent and Salvage Corps are small organisations with rather special requirements which do not always coincide with a brigade's. As a result of this situation, there are a number of aspects of the design and supply of equipment which are not satisfactory:

- there is a need for the refinement of salvage equipment on first-line appliances. This should be light, compact and easy to maintain and use,
- the economics of the provision and use of disposable equipment should be investigated. This particularly applies to sheets, roofing materials, and dams. The use of brigade manpower for the construction, recovery, cleaning and repair of salvage equipment could well be uneconomic and might discourage the full use of the equipment,
- the possibilities of standardisation, bulk buying and call-off ordering should be explored to reduce the unit cost of equipment.

This work is discussed in detail in Appendix V.

11.5 Reporting

In addition to a report written for the Home Office, and for other parties assisting in the study, there will probably be a need for a document for distribution to brigades which specifies the conclusions of the work and gives other information collected during the course of the study which might be useful to brigades. The material to be included in this document will need to be carefully chosen.

At a later stage, individual brigades might wish to discuss the opinions expressed in the document with members of the Scientific Advisory Branch or with the study team. Adequate arrangements will be needed to enable this to be done.

LEVELS OF SALVAGE EFFORT ASSUMED FOR THE PILOT STUDY

The four levels of salvage effort considered in the pilot study are defined below.

No salvage

It was assumed that the only salvage to be carried out is that which a fireman might regard as good firefighting practice e.g. shutting doors, taking care in laying hose, not spreading debris etc.

The present level of salvage

This was interpreted as meaning the level of salvage effort found in the study brigade, and could well be above the level of salvage activity found in many other brigades. The pilot brigade is very conscious of the need for salvage, a number of its officers have been on salvage training courses and the brigade uses quite a lot of salvage equipment which is carried on first-line appliances. In addition to this the brigade maintains a salvage tender which is manned by two men and is called out to appropriate incidents, together with another appliance whose men are allocated to salvage duties.

Extra salvage

In this case we have assumed the employment of two small 35 cwt. salvage tenders, each manned by three men and located at strategic stations in the city. Costs for the running of these tenders are based on costs incurred for similar tenders by a Salvage Corps. It is to be stressed that this is not to be regarded as the best method of increasing salvage effort, but only as one possible method.

Maximum salvage

The intention here was to assume that all the salvage that could be done was done and to work out the manning needed for this at the end of the study. However, no case was found where the level of salvage effort required was greater than that assumed in the 'Extra Salvage' level given above.

DATA FORMS

This appendix contains copies of data forms 1 to 4 as used in the pilot study and describes the method used for the completion of data forms, and gives notes on the interpretation of certain items entered on the forms (Section 3.5 refers).

DATA FORM 1

LOSS ESTIMATES FOR SAMPLE FIRE

Fire No:

Date:

Time:

Address:

*① Occupier's Name:

Occupier No. 1.

Number of other occupiers
affected (if any):

Trade of Occupier:

② Sections of building occupied:

③ Loss Adjuster:

④ Approximate Loss (f)

Building

Machinery

Stock

Consequential

5 Salvageable or part salvageable
Items (£)
(totals b.f. from analysis
sheets)

⑥ Difference between above and 'actual' (£)

Amount by which the actual consequential loss would have changed if the amount of salvage carried out had changed

Comments:

DATA FORM 2

ANALYSIS FORM:

DIRECT LOSSES ATTRIBUTED TO SALVACABLE OR PART-SALVACABLE ITEMS

Fire No: Occupier No. I Sheet No. of

Description	Specify if Applicable	No Salvage	Actual	Extra Salvage	Maximum Salvage
7 Sub Total b.f.					
Total, or Subtotal c.f.					

SALVAGE DATA FOR SAMPLE FIRE

DATA FORM 3
Sheet 1

Fire No:

Date:

Brigade:

Address:

Occupier's Name(s):

Type(s) of business:

Time of brigade arrival:

Time salvage work commenced:

Appliance in use:

No. of personnel:

Floor(s) of fire:

Proportion of building involved in fire:

Proportion of building suited to salvage operations:

Number of waterproof sheets available:

Number of waterproof sheets used:

Other equipment used:

	Actual	Extra salvage (requirement in excess of 'actual')	Max. salvage (requirement in excess of 'extra')
<p>Number of men employed on salvage work during fire fighting:</p> <p>Approximate time employed:</p>			
<p>Number of men employed during recovery period:</p> <p>Approximate time employed:</p>			

Comments:

SALVAGE ACTIVITIES

⑩ ACTIVITY	⑫ IMPORTANCE OF ACTIVITY*	⑬ EFFECTIVENESS	
		ACTUAL (% of maximum)	EXTRA SALVAGE (% of maximum)
Removing contents			
Covering contents with waterproof sheets			
Carpets			
Damming and diverting water			
Drains and manholes			
Sprinklers			
Protecting adjacent and adjoining property			
Reducing smoke damage			
Removal of water			
Prevention of sundry damage			
Drying premises			
Prevention of smoke odour damage			
Prevention of deterioration of contents			
Oiling machinery			
Protection from inclement weather			
Securing premises			

* blank
1.
f.
v.

INTERACTION DATA FOR SAMPLE FIRE

DATA FORM 4

Fire No:

14

INTERACTION TYPE	IMPORTANCE*	COMMENTS	REFERENCE
5 Use of firefighting manpower			2.2
6 Attention from officer in charge			2.3
Effect of choice of firefighting method			2.4
Need for skill in minimising damage			2.5
Shortage of space for salvage equipment on firefighting appliances			2.7
Recovery and cleaning of salvage equipment			2.8
Salvage causes conection on the fireground			2.9

- * 0 or blank = interaction not applicable
 1,2 = very little importance
 3,4 = little importance
 5,6 = fairly important
 7,8,9 = very important
 10 = interaction so great that firefighting or salvage operations are prevented.

Detailed method of completion of Data Forms

The method given below is that which would be employed at large fires. Certain simplifications are possible at small fires.

While firefighting is in progress the team concentrates on observing and recording firefighting activities being carried out. The top part of Data Form 1, the top part of Data Form 2 Sheet 1 and most of Data Form 4 can now be completed. It should also be possible to visualise a 'maximum salvage' level and hence to complete the first two columns of the top part of Data Form 3 Sheet 2 (i.e. the part of the form which refers to salvage action taking place concurrently with firefighting).

When the fire is extinguished an estimate is made of what extra salvage work could have been done if the 'extra salvage' alternative were to be adopted and the third column of the top part of Data Form 3 Sheet 2 is completed. The officer-in-charge of the fire is then consulted as to what salvage is to be done during the recovery phase and the remainder of Data Form 3 Sheet 2 is completed. If the extent of such work is very great, it may be necessary to make another visit to the scene of the fire.

The property is then inspected, floor by floor and room by room, to enable Data Form 2 to be completed. Since in the case of industrial fires a number of occupiers and loss adjusters may be involved, it is necessary to complete one Form 2 for each occupier. Direct loss estimates for each of the four salvage levels need to be made. In some cases it is not possible to make an on-the-spot valuation of particular stocks or machinery which were saved by salvage or which might have been saved by salvage. The location and description of such items is entered on Form 2 and percentage figures entered into the columns to represent the percentage of the value of the items which would have been lost.

The remainder of the Data Forms can now be completed. It may, however, be necessary for the loss adjuster appointed by the insurance company to be contacted the following morning to clear up any outstanding valuations.

Notes on the completion of the Data Forms

The notes given below refer to the heading indicated on the specimen Data Forms included at the beginning of this appendix.

NotesForm 1

- ① A Form 1 is completed for each occupier, since, in the case of a multi-tenant building a number of loss adjusters may be involved in assessing the loss.
- ② This is needed to check that no part of the building is omitted.
- ③ For many fires no loss adjuster is appointed (e.g. small housefires). In these cases estimates of loss are made by the team loss adjuster.
- ④ Loss adjusters normally have available approximate loss estimates by the morning after the fire, so that the insurance company can be informed of the likely extent of its liability. These estimates are provisional and non-agreed figures, and may be an overestimate in the case of consequential loss. For this reason, and also because it is difficult to estimate consequential loss, we will keep consequential loss estimates separate from other estimates of loss.

Form 2

- ③ There may be more than one analysis sheet (Data Form 2) for a large fire, or none at all if no salvage work was possible at a fire.
- ⑥ These values are determined by estimating for each level of salvage effort, the length of time that a firm would be out of business. The value of this time is then calculated as a proportion of the estimated actual consequential loss.
- ⑦ In general, the method of completing Form 2 is floor by floor and room by room, so that a typical line of the form might refer to the salvagable contents of a specified room. However, it may well be advisable at some fires to vary this approach, so that for instance a line might refer to a particular machine or to building/machinery/

stock classifications rather than contents at particular locations.

In cases when values cannot be estimated at the time of the fire, percentage figures are entered to represent the percentage of the value of the items which would have been lost.

Form 3

One Form 3 is completed for each fire attended.

- ⑧ The number of men employed on salvage will not remain constant throughout firefighting operations, and the figure entered here represents the average commitment from commencing salvage work to beginning the recovery period.
- ⑨ The time employed includes only time employed at the scene of the fire and does not include any allowances for turn-out or return to station, or for cleaning equipment etc. afterwards.
- ⑩ & ⑪ The activities mentioned are specified more exactly in the reference to the document 'The Components of Salvage'. Thus 'Carpets' refers to activities described in section 2.2.4 which covers the methods to be used for protecting various types of carpet.
- ⑫ 'Importance' ideally refers to the value of the particular activity measured in terms of the reduction in loss which would be attributable to the activity if it were correctly carried out. However we are not attempting to evaluate the effect of individual activities, but only of various 'levels of salvage' viewed as a whole, and so importance will be assessed on a subjective scale rather than a financial scale.
- ⑬ Effectiveness, entered as a percentage, measures the extent of realisation of the benefits which might have been gained by carrying out a particular activity.

Form 4

Form 4 refers to interactions between salvage and firefighting, and one line of the form is allocated to each type of interaction. However, two types of interaction are not represented. Firstly, it is

not possible to evaluate competition for training facilities by visiting fires, and secondly it is unrealistic to expect a fireman to reveal a preference of firefighting work to salvage work when it is known to him that a study of salvage is being done.

- ⑭ The importance of each type of interaction is measured in a scale of 1 to 10.
- ⑮ In the case of the interaction 'Use of firefighting manpower', its importance depends on whether or not there is a shortage of firefighting manpower at the scene of the fire and on the benefit which might have been gained by switching salvage effort to firefighting or vice versa.
- ⑯ In the case of the interaction 'Attention from officer-in-charge', importance depends on the value of the time he spends organising salvage effort, and on the avoidable cost incurred if the commencement of salvage is delayed.

POSSIBLE METHODS OF ORGANISING THE DATA COLLECTION FOR PHASE 1

During the pilot study it was apparent that our data collection method needs to be modified to encompass a greater fire incidence rate. The possible ways of doing this are as follows:

- cover a larger area, either the London conurbation or a larger number of provincial brigades,
- make use of the possibility of visiting fires up to four days after they occur. However, if this was done, there would be a reduction in the accuracy of estimates made,
- run the exercise as a 'part-time' activity, based on cities with Salvage Corps, and employing local loss adjusters, so that the data collection team had available other activities to fill in slack time.

Various combinations of the above three modifications give rise to a number of alternatives for data collection. The most promising of these alternatives are described below, ordered according to whether they are based on London, on single centres other than London or on multiple centres.

Alternative 1: A team based in London operating continuously

In this case, a loss adjuster and a salvage expert would need to be allocated to the study for three months and would work on a 9 a.m. to 5 p.m. five day week basis. They would attend fires as they occurred during the day (over the whole Greater London area), and would utilise a 'backlog' of incidents which had occurred during the previous night to increase their time utilisation. Class A incidents would not be attended.

Alternative 2: A team based in London, operating intermittently

In this alternative, a loss adjuster and a salvage expert would be allocated to the study on a one-day-per-week basis for a year. The team could attend fires as they occurred during the day, as in alternative 1

but would be able to draw upon a larger backlog of fires which had occurred during say the previous three days. This alternative might be easier to organise from a Salvage Corps point of view, and therefore might be preferred by them to alternative 1, though the results of the data collection would be delayed.

Alternative 3: A team based at a single provincial centre and operating continuously

In this alternative, difficulties might be expected in providing an adequate fire incidence to keep a team busy on a continuous-attendance basis. It would be necessary for a very wide area to be covered, so that the team would spend a larger proportion of their time in travelling to incidents and a communication problem might be involved with the large number of cooperating brigades which would be needed. Thus only few fires per day could be handled (say two). This alternative can therefore be rejected as not being economical to implement.

Alternative 4: A team based at a single provincial centre other than Liverpool or Glasgow and operating intermittently

In this case, time would be required for the Salvage Corps team member to travel to and from the other centre, but better use might be made of a backlog of fires than in the case of alternative 3 and the number of brigades involved would not be as large. Difficulties would probably be experienced with variations in the incidence rate.

Alternative 5: A team based at Liverpool or Glasgow and operating intermittently

If the provincial centre chosen in alternative 4 were Liverpool or Glasgow, this would eliminate the need for the Salvage Corps member to travel between centres and he would have other work to do during slack periods. Visits to 'backlog' incidents could be pre-arranged by the

Salvage Corps officers attending the original incident, and no visit would be needed to incidents where no salvage was found necessary.

Alternative 6: A team travelling between centres, operating continuously

In this alternative, the team would operate from 'backlogs' in a number of centres and would travel from one centre to another centre as soon as the backlog at the first centre was exhausted. This alternative would be more efficient to operate than alternative 4, but would be physically wearing on the team and it would not be possible to employ local loss adjusters.

Preferred alternatives

In our opinion, of the six alternatives described above, alternative 2 and alternative 4 are to be preferred. These involve Salvage Corps and loss adjusters working in their own area, and a number of technical and political points arise:

- Salvage Corps tenders will attend many of the fires visited by the team. At these fires it will therefore be necessary to estimate what salvage might have been done by the brigade's first-line appliances if the Salvage Corps had not attended. Care will be needed in defining this level of salvage effort,
- difficulties might be experienced in the relationship between brigades and Salvage Corps since the data collection team would be visiting some fires not attended by Salvage Corps,
- London fires might be considered 'special' because of the peculiar nature of the risk and callout arrangements. It might be necessary at the end of the exercise to apply a statistical correction to the results to allow for this,
- the loss adjuster would be attending fires, some of which were being dealt with by other loss adjusters in the same area.

However, he would not need to know the name of the company for

whom they were acting and our experience in the pilot study suggests that no breach of confidentiality or unfair competition would be involved.

The above disadvantages are not major ones, and are counterbalanced by advantages such as ease of administration, the possibility of sharing the workload between individuals, the elimination of the need for prolonged periods away from home, flexibility of organisation, easy access to fires, the possibility of eliminating some fires without the team's attendance, and reasonable rates of incidence.

THE INCIDENCE OF FIRES IN NON-DERELICT BUILDINGS IN LONDON, LIVERPOOL
AND GLASGOW, BASED ON 1967 K433 FIRE REPORTS

	CLASS A	CLASS B	CLASS C	CLASS D	TOTAL
London	8888	2138	319	250	11595
	77%	187.	2.8%	2.2%	100%.
Liverpool Area (see below)	2010	384	69	49	2512
	80%	157.	2.7%	2.0%	100%.
Glasgow	2234	358	54	77	2723
	82%	13%	2.0%	2.8%	100%.
National Total	60743	12158	2077	1677	76655
	79%	16%	2.6%	2.2%	100%
Pilot Brigade	79%	16%	3.3%	2.0%	100%

Note:

The Liverpool area includes Birkenhead, Bootle, Liverpool, St. Helens & Wallasey brigades. Similar information for a sample of other brigades is given in the table overleaf.

THE INCIDENCE OF FIRES IN NON-DERELICT BUILDINGS IN A SAMPLE OF
BRIGADES, BASED ON 1967 K433 FIRE REPORTS

	CLASS A	CLASS B	CLASS C	CLASS D	TOTAL
Barnsley	68	10	0	1	79
	86%	13%	0%	1.3%	100%
Darlington	104	26	4	2	136
	77%	19%	2.9%	1.5%	100%
<i>Margate</i> Myther Tydfil	59	15	2	1	77
	77%	19%	2.6%	1.3%	100%
Southend	151	38	7	3	199
	76%	19%	3.5%	1.5%	100%
Berks & Reading	257	48	8	7	320
	80%	15%	2.5%	2.2%	100%
Hertford	796	130	21	21	968
	82%	14%	2.2%	2.2%	100%
Suffolk & Ipswich	502	101	11	7	621
	81%	16%	1.8%	1.1%	100%
Perth & Kinross	174	30	4	8	216
	81%	14%	1.9%	3.7%	100%

THE NEED FOR THE TECHNICAL DEVELOPMENT OF SALVAGE EQUIPMENT

This appendix specifies in more detail the need for technical developments which is outlined in Section 11.4, and gives some ideas which might serve as a first step towards satisfying the need. Two general types of equipment are involved, equipment for first-line appliances and equipment for specialist tenders.

Equipment for first-line appliancesSalvage sheets

There is a need for the development and supply of lightweight disposable sheets. These might, for example, be 12' x 12', made out of 500 or 250 gauge polythene, and supplied cut and folded in dispensers which might hold half a dozen sheets. A simple system could be used to indicate when a new supply is required on a given appliance by including in the dispenser a re-order form after the fifth sheet. It could well be possible to supply replacement dispensers for about £1.50 each. This would reduce considerably the capital expenditure required to equip a brigade with sheets, since at the moment PVC sheets cost about £7 each for materials alone. (Note: an item with a cost of £7 and which lasts ten years is equivalent in cost to an annual mortgage repayment of £1 p.a., if we assume an interest rate of 10%. A disposable dispenser supplied at a cost of £1.50 would therefore only have to last for 18 months for its cost to be comparable with that of one salvage sheet carried on an appliance, ignoring making, cleaning, etc. costs).

Lightweight sheets are unsuitable for slinging, protecting carpets, or for substantial covering. It may possibly be desirable to carry both PVC covered sheets and disposable sheets on appliances (say one PVC sheet and one pack of disposable sheets per appliance). Research is needed into the best 'mix' to carry.

Dams

Present methods of preventing the lateral spread of water are unsatisfactory. Dollies or folded sheets, and sawdust are often employed for this purpose but they are bulky, heavy and messy to use and are not very efficient. There is a need for the development of three types of dam:

- dams for doorways, which must be adjustable in size, easily clamped into position, firm to withstand kicking, watertight if the floor is uneven, and easy to store on an appliance,
- dams for corridors, stairwells etc., which must have the same characteristics as the above,
- a method of preventing lateral spread of water over a larger floor area or to a valuable machine or pile of stock.

It might be possible to develop a device looking like a fire extinguisher and containing a foam or other compound which would form a solid barrier on exposure to air or water and which would adhere to a floor. This one device would serve all three purposes and would be both more effective and less bulky than current methods. A method would need to be devised for cleaning up afterwards.

Equipment for collecting drips

Collapsible trays, say 3 ft. square with a plastic insert are useful for collecting drips and might be made available to brigades.

Equipment for breaking in and securing afterwards

Work is needed on method of entry into premises, to try to reduce the damage done and the delay in gaining entry. Work is also needed to devise a satisfactory method of securing the front doors of unoccupied premises after entry has been gained.

Equipment for salvage tenders

There are a number of types of equipment which might be developed for carrying on salvage tenders. However since the number of such tenders is relatively small we feel that this work is secondary to the development of equipment for first-line appliances and should not be undertaken till a policy for the location of salvage tenders is developed.

Oiling machinery

Work could be carried out on methods of protecting machinery, on the effectiveness of dewatering oils and on the availability of a hand-operated pressure spray suitable for thick oils. Some literature is needed on methods of oiling common types of machinery.

Removing water

A Which-type report on pumps could be compiled to compare various capacities of pump, compare electric pumps with internal combustion engine pumps, and comment on ease of cleaning, ease of use, and reaction to debris of various makes. Work could be done to determine the advisability of carrying electric squeegees on tenders and if necessary a manufacturer might be persuaded to develop a self-emptying electric squeegee.

Removing foam and smoke

If brigades expand the use of foam for firefighting, further work will be needed to develop foam extractors. Current chemical methods of removing foam are thought inadequate. Similarly it may be possible to reduce smoke damage by using smoke extractors.

Prevention of smoke odour damage

A review of the effectiveness of current methods of reducing odour damage would be valuable.

Roofing

Various different materials are used for temporary roofing, and some brigades use canvas salvage sheets for this purpose. An evaluation could be done of the economics of using disposable heavy-gauge polythene for roofing work.

VARIATIONS IN THE FIRE INCIDENCE RATE IN THE PILOT BRIGADE

The table below compares the fire incidence in the pilot brigade during the pilot study period with the incidence in other periods of similar length. It can be seen that there is a large variation in the incidence of fires measured over periods of one or two weeks (see also Figure 7.1).

<u>Week beginning</u>	Fires we would have attended* if the data collection exercise had been conducted <u>in this week</u>
4th Jan. 1970	13
11th Jan. 1970	14
18th Jan. 1970	13
1st Feb. 1970	11
8th Feb. 1970	24
31st May 1970	9
7th June 1970	7
2nd Aug. 1970	7
<u>9th Aug. 1970</u>	<u>8</u>
First week of pilot study	3
Second week of pilot study	6

*These figures exclude fires in neighbouring brigade areas and assume the rules used in the pilot study for determining whether fires should be attended i.e. fires in sheds, greenhouses, garages, huts, unoccupied buildings etc. are excluded. (See Section 5.3).

CLASSIFYING FIRES FOR SALVAGE WORK

The reasons for classifying fires in this research are as follows :

- to enable the team collecting data to determine whether or not to attend a given incident. In the case of fires attended concurrently with or shortly after the brigade attendance, it is necessary to base this decision on information available at brigade control during early stages of firefighting. This information might consist of a brief description of the type of premises involved (e.g. 'warehouse'), with an indication of which floors are affected, plus an outline of the method of firefighting in use (e.g. 'one jet').
- to enable results to be generalised to refer to different brigades or to refer to the whole country. This implies that the classification cannot be based on observations of salvage techniques employed, since salvage work is often not recorded and since salvage techniques may vary between brigades. It is therefore desirable to base a classification on information recorded on K.433 fire report forms, because these are standard reports collected on a nationwide basis for statistical analysis,
- to enable stratified sampling techniques to be employed to improve the accuracy of estimates of the benefits of salvage. This would involve the classification of incidents to reduce the variance of the benefit within each class and the choice of greater sample proportions for classes with greater variance.

The method of classification used in the pilot study is an attempt to achieve the above aims by a single classification of fires. Thus, the classification is based on information recorded on K.433 fire reports, but many of the fires which would not need to be visited (Class A)

could be identified from information available to brigade control. We do not yet have a large enough sample of fires to test the success of the B/C/D classifications in reducing the variance of the benefits within each class, but the definitions of Classes B, C and D could be modified if necessary during the main study.